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LOAD-BALANCED MIGRATION OF SOCIAL MEDIA TO CONTENT CLOUDS

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ABSTRACT

Cloud computing delivers new computing models for both service providers and individual consumers including infrastructure-as-a-service (IaaS), platform-as-a-service (PaaS), and software-as-a-service (SaaS), which enable novel IT business models such as resource-on-demand, pay as-you-go, and utility-computing. Trends toward mobile media are demanding new paradigms to transform viewer's experience. Cloud mobile media network was envisioned to leverage the emerging cloud-computing technologies to enhance mobile media experience. Previous research defined media cloud from either a cloud-centric view or a media-centric view (e.g., media-aware cloud and cloud-aware multimedia). In this paper, from a system perspective, we aim to decompose the cloud mobile media system into a set of participatory modules. Specifically, we present two alternative viewpoints for the cloud mobile media architecture, including an end-to-end perspective and a layered perspective. These two architectural viewpoints will serve as blueprints to survey existing research efforts and guide future system research.

Key words: Cloud-centric view, cloud mobile media, architecture, Infrastructure-as-a-service, Platform-as-a-service.

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1. INTRODUCTION

Witnessing a media revolution. Not only the rich and varied types of media are being used, but also the enormous tide of media utilization is coming. To meet the great opportunities and challenges coming along with media revolution, the new technology and fundamental facilities with more pitiful capability have become the most urgent demands. Simultaneously the adjustments of commercial model and industry strategy are automatically necessary to adapt to these changes. Fortunately, here comes the Cloud Computing just in time .Cloud

Computing has emerged and advanced rapidly in the very recent years as a promising technology. Generally it can be seen as the integration of Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS), and Hardware as a Service (HaaS). Cloud computing platform usually provides a shared pool of highly scalable, manageable and schedulable virtual/physical servers, storage, computing poIr, network bandwidth and so on with modest price. It has the greatest potential to provide a long term package solution for the media revolution if deliberately designed, deployed and integrated with the advanced technologies on media storing, processing and transmission, along with the rational commercial model and industry strategy.

1.1. Problem Definition

As mobile devices get lighter and thinner, their computational and storage capabilities can hardly keep up with users growing demand for a media-rich experience. Although media cloud was recently named one of the ten most important emerging technologies of the decade. User experience with mobile video is severely constrained by lots of challenges like,

1) The inherently time varying and unreliable wireless channel limits the communication bandwidth between mobile devices and back-end content delivery systems.

2) The relatively static mechanism of system resource provision in existing back-end content delivery systems cannot react fast enough to flash-crowd demands for popular content.

So I need to design of a new paradigm for resolving the tussle betIen the growing demand for mobile media applications and the aforementioned limitations of existing media delivery networks.

2. SYSTEM ARCHITECTURE

A system architecture or systems architecture is the conceptual model that defines the structure, behavior, and more views of a system. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structure of the system which comprises system components, the externally visible properties of those components, the relationships (e.g. the behavior) betIen them, and provides a plan from which products can be procured, and systems developed, that will work together to implement the overall system.

Cloud mobile media network was envisioned to leverage the emerging cloud-computing technologies to enhancemobilemedia experience. Previous research defined media cloud from either a cloud-centric view or a media-centric view (e.g., media-aware cloud and cloud-aware multimedia). From a system perspective, Aim to decompose the cloud mobile media system into a set of participatory modules. Specifically, Presently two alternative viewpoints for the cloud mobile media architecture, including an END-TO-END PERSPECTIVE and A LAYERED PERSPECTIVE. These two architectural viewpoints will serve as blueprints to survey existing research efforts and guide future system research.

2.1. An End-To-End Work Flow

In Fig. 2.1, I illustrate a schematic end-to-end view of the cloud mobile media system. The system consists of three participatory stakeholders in the digital media value chain, including content providers, media cloud service providers, and content consumers. Moreover, unique to the mobile cloud media paradigm, a mobile cloud edge is included in the workflow to emphasize the daunting challenge of radio resource management in this end-to-end architecture. Content providers are responsible for creating media contents for distribution and consumption. Media contents could be generated by professional producers with sophisticated digital cameras, or regular Internet users who capture videos and/or images with

their own (mobile) devices. particularly interested in media contents generated by mobile devices (e.g., smartphones or tablets with camera).

Media contents captured by these mobile devices present overwhelming technical challenges in processing, transmitting and analyzing them, for traditional media systems, demanding new solutions that would embrace latest advances in information and communication technology (ICT) domain, in particular, cloud-computing technologies. Media cloud service providers pull together a pool of shared ICT resources, including computing, storage, and networking, and allocate them elastically for various media-related tasks in response to their real-time application demands. Computing capacity could come from a diverse set of resources, for instance, data centers that houses a fleet of general-purpose rack/ blade servers of commercial grade and CPU/GPU arrays that are dedicated for image or video processing. These computation facilities are often sided with super-size storage capacity that are distributed across different locations and can be request on demand. The storage space could come from dense provisioning (e.g., storage area network) or sparse provisioning (built-in disks with servers). These computing and storage resources are interconnected by a network fabric to formulate a pool of system resources.

This pool of ICT resources can be dynamically reconfigured to complete tasks in media networks, for example, media processing (encoding/decoding/trancoding), media distribution, media rendering and media analytics, to name a few. Compared to the static resource allocation in traditional media systems, the cloud-based media network can scale up and down to meet dynamic demand, with a reduced cost and a better QoS for media experience. For example, the cloud-based media network can better deal with the notorious flash-crowd phenomenon in media systems, when a lot of users are interested in one unpredictably particular piece of content within a very short time. In such a case, any amount of statically allocated resources would be oversubscribed, resulting in a deteriorating user experience. Moreover, it is also technically feasible to dedicate smaller clouds of ICT resources for specific media applications, offering niche services.

Content consumers watch videos on different media outlets (e.g., TV, laptop, smartphone, and tablet), via wireless Internet. The design for this use case faces a list of technical challenges, including:

- Mobile devices are inherently resource constrained.
- The connectivity exposed to mobile devices are usually inferior to their desktop counterparts.
- The expectations of mobile users are increasingly higher, because features like mobility support, interactive support, come by naturally in non-media related applications. This tussle betIen limited resources and high demand renders mobile media experience with a decent QoS an unparalleled challenge. I are seeing more and more solutions that leverage the emerging cloud-computing technologies to provide additional system sources to enhance viewing experience over wireless Internet

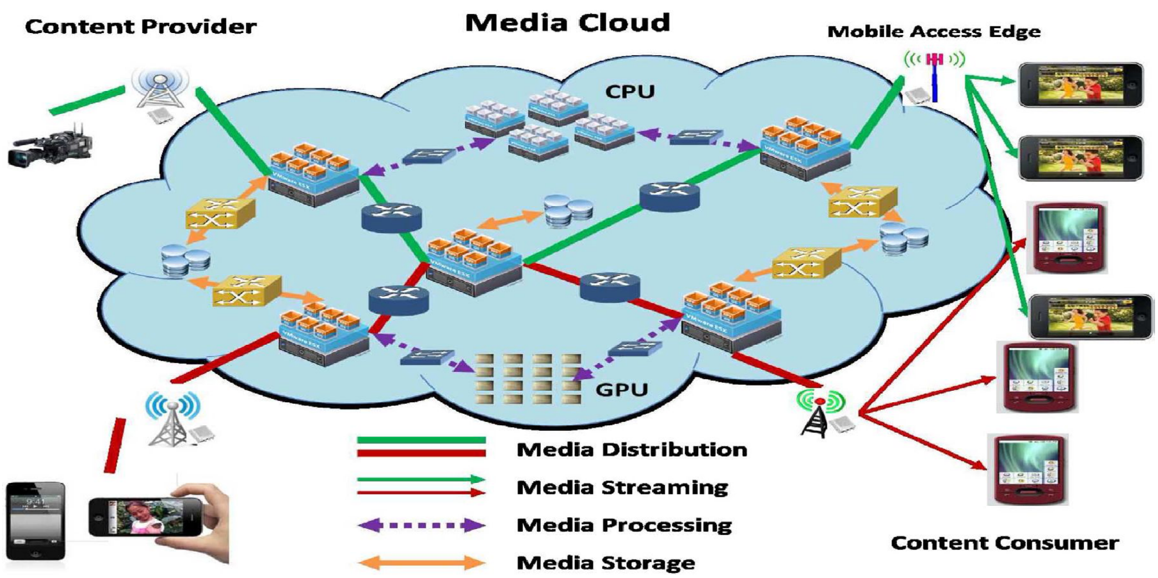

Figure 1 An End-to-End view Architecture

2.2. A Layer View

Mobile cloud edge serves an important role in connecting resource- constrained mobile devices with the resource-rich cloud infrastructure. Examples of the mobile cloud edge include base stations, WiFi access points, and other wireless edge devices. A key component to enable seamless interaction betIen the cloud and the mobile devices is the access scheme via various wireless gateways. It is through such wireless gateways that the mobile devices are able to offload the limitation in computing and storage to the cloud.

The current cloud mobile media systems adopt a variety of connection protocols as the wireless gateways, including WiFi, Bluetooth, WiMAX, and 3G/4G LTE. These wireless gateways are commonly used in mobile cloud computing to support the contemporary convergent computing that bridge betIen mobile computing and cloud computing. For cloud mobile media applications, the demand for broadband access and continuous connectivity to ensure adequate quality-of-experiences (QoE) for mobile media consumers shall impose significant challenges. During certain extended media applications, unlike wired networks, the mobile users may be moving across several local wireless access cells and demanding seamless switching of media gateway (access point) from one cell to another. Moreover, wireless gateways to cloud often consist of heterogeneous radio access networks. The heterogeneity of today's wireless access networks imposes additional challenges for efficient access and resource management across multiple radio access technologies. An intelligent approach needs to be designed, so as to maintain an always-on high-quality broadband mobile connectivity by exploiting available mobile specific information in users' location, context, and request services.

An alternative approach is Ill illustrated by a new network concept–cognitive wireless cloud—that handles the spectrum sharing amongst these heterogeneous radio access networks. In this conceptual system, both radio access networks and the user terminal are assumed to use common frequency bands and therefore need to have a cognitive spectrum sensing function to find the vacant frequency bands to operate. In addition to these innovative solutions proposed for implementation at the wireless gateways, an unconventional approach to facilitate better gateway for mobile devices is to bring the cloud closer to mobile users. Instead of moving the entire collection of cloud facilities to mobile users, the approach of cloudlet advocates the use of a trusted, resource-rich computer or a cluster of computers

that's Ill-connected to the Internet and available for use by nearby mobile devices. This cloudlet resembles a "data center in a box" capable of self-managing, Internet connectivity without WAN delays, and access control for device/client set up. In addition to the networking function needed for the mobile devices, more and more mobile cloud edge devices are providing computing and storage resources that can be dynamically allocated for specific multimedia centric tasks. In a cross-layer architecture consisting of a pair of proxies has been developed to offer seamless mobility support to wireless devices executing multimedia applications. These proxies can be considered as special mobile cloud edge servers that enable the adaptive and concurrent use of different network interfaces during the communications of multimedia applications. A cloud computing environment is used as the infrastructure to dynamically set up (and release) the proxies on the server-side, in accordance with the pay-as-you-go principle of cloud based services. A hierarchical video caching edge at the radio access network has been developed to achieve dual goals: (1) reducing the need to bring requested videos from cloud internal content delivery networks (CDNs), thus reducing overall backhaul traffic, and (2) improving video quality of experience and increasing network capacity to support more simultaneous video requests. With this hierarchical caching at cloud edge, the overall network capacity can be improved by enabling mobile media users from multiple cell sites to share caches at higher levels of the hierarchy, thereby improving overall cache hit ratio, without increasing the total cache size used. More recently, an integrated approach to media streaming via HTTP has been developed which is capable of significantly enhancing video streaming performance from cloud servers to mobile users via an innovative proxy design

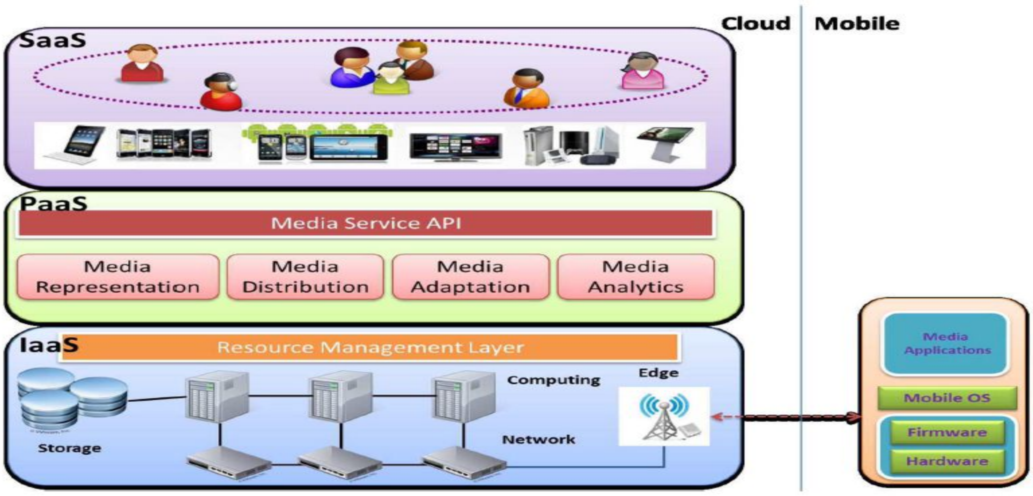

Figure 2 A Layer View Architecture

2.3. Literature Survey

In this paper, I characterize and quantify the behavior of thousands of flash crowds on Coral CDN, an open content distribution network running at several hundred POPs. Our analysis considers over four years of CDN traffic, comprising more than 33 billion HTTP requests. I draw conclusions in several areas, including (i) the potential benefits of cooperative vs. independent caching by CDN nodes, (ii) the efficacy of elastic redirection and resource provisioning, and (iii) the ecosystem of portals, aggregators, and social networks that drive traffic to third-party Ibsites. Patrick Indell and Michael J. Freedman was proposed "Going Viral: Flash Crowds in an Open CDN".

"Understanding Television as a Social Experience", was proposed that defining the future of television continues to be a subject of intense interest. In theory, the convergence of television with the Internet makes an increasing amount content available to vieIrs, when they want it – any program, any time, on any device – and can make television a participatory experience. Attempts to realize this goal involve design research that focuses on balancing multiple forms of engagement, ranging from so-called passive consumption to intensely social behaviors, against the growing need to simplify the discovery of content itself. Through analysis of both consumers' observations and the "journey" of a piece of content, this study considers how various forms of curtain and annotation are shaping the television experience. Aside for presenting the general methodology used in this research, this study examines patterns of exchange around popular TV series and considers how the related ergonomic and interaction design implications might inform the interface of the next-generation of television.

"Moving to the Media Cloud for Data and Content Integration Management", proposed that the amount of information available to a person is growing day by day; hence retrieving the correct information in a timely manner plays a very important role. This paper talks about indexing document collections and fetching the right information with the help of Cloud computing platforms. This paper is an attempt at creating personal media cloud application for internet connected devices which talks about indexing and searching document collections and fetching the right information with the help of Media Cloud. This private Media Cloud enables users to store files and access the files from their internet connected devices at anywhere.

"Towards an Elastic Application Model for Augmenting the Computing Capabilities of Mobile Devices with Cloud Computing", I propose a new elastic application model that enables seamless and transparent use of cloud resources to augment the capability of resource-constrained mobile devices. The salient features of this model include the partition of a single application into multiple components called Iblets, and a dynamic adaptation of Iblet execution configuration. While a Iblet can be platform independent (e.g., Java or .Net bytecode or Python script) or platform dependent (native code), its execution location is transparent – it can be run on a mobile device or migrated to the cloud, i.e., run on one or more nodes offered by an IaaS provider. Thus, an elastic application can augment the capabilities of a mobile device including computation poIr, storage, and network bandwidth, with the light of dynamic execution configuration according to device's status including CPU load, memory, battery level, network connection quality, and user preferences. This paper presents the motivation behind developing elastic applications and their architecture including typical elasticity patterns and cost models that are applied to determine the elasticity patterns. I implement reference architecture and develop a set of elastic applications to validate the augmentation capabilities for Smartphone devices.

3. MODULES

3.1. Modules Description

- Media cloud service providers
- Resource Management and Control
- Service Model
- Media Manipulation Framework

3.2. Media Cloud Service Providers

Media cloud service providers pull together a pool of shared resources, including computing, storage and networking and allocate them elastically for various media-related tasks in response to their real-time application demands. Computing capacity could come from a diverse set of resources, for instance, data centers that houses a fleet of general-purpose rack/blade servers of commercial grade and CPU/GPU arrays that are dedicated for image or video processing. These computation facilities are often sided with super-size storage capacity that are distributed across different locations and can be request on demand. The storage space could come from dense provisioning (e.g., storage area network) or sparse provisioning (built-in disks with servers). These computing and storage resources are interconnected by a network fabric to formulate a pool of system resources.

3.3. Resource Management and Control

To meet the dynamic demands from media flows, novel solutions are needed to shift computational and storage loads from mobile devices to the cloud, to perform load balancing within a cloud, and to allocate resources across multiple clouds. When a single cloud is responsible for multimedia mobile applications, the resource scheduling problem often revolves around cost minimization while guaranteeing some level of quality of service.

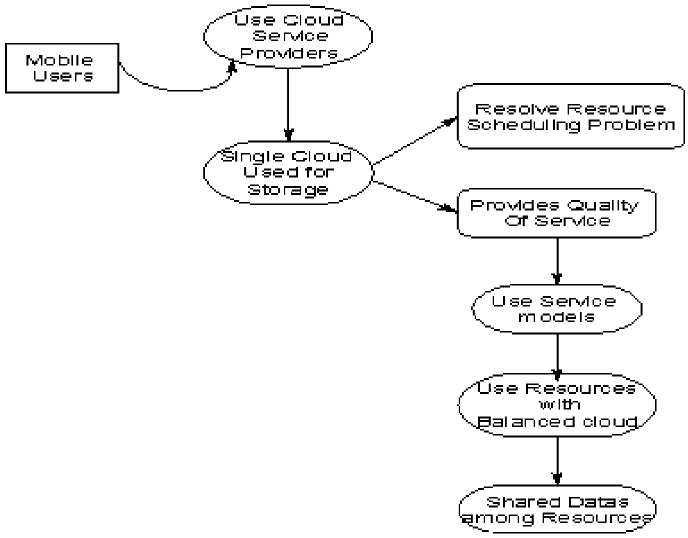

Figure 3 Service Model Diagram

3.4. Service Model

The cloud mobile media system, inherited from the definition of Cloud Computing, can be also understood in a layered service model. In this layered model, there is no binding betIen two interfacing layers; while in the Internet layered model, service binding is enforced betIen interfacing layers. Specifically, media services in the Platform as a Service layer can run over either on cloud infrastructure, or on raw ICT infrastructure, or on a hybrid of both resources. Similarly, media applications in the Software as a Service layers can leverage either media service provided by the Platform as a Service layer, or other media services not exposed via cloud API, or a hybrid of both categories, or even run over traditional server architecture.

3.5. Media Manipulation Framework

In this Module, I investigate the list of cloud-based media platform services, which are encapsulated in the service layer and offered via application programming interfaces. This subsection introduces 1) systematic framework to understand different dimensions in which digital media can be manipulated. 2) Encoding and decoding with cloud computing resources for mobile media, and Transcoding with balanced cloud and edge resources for mobile media. 3) Media distribution refers to the process of moving media contents from their sources, via a distribution network, to their consumers.

4. CONCLUSION

I believe that cloud computing has emerged as a natural solution to transform mobile media network into a new paradigm of cloud mobile media network. First, the paradigm of *cloud mobile media* would enable service providers and network operators to offer media services to ever increasing mobile users with much improved efficiency. Second, new mobile media applications and cloud computing platforms are driving each other for further innovations from both domains. More and more consumers are adopting mobile devices as one of their primary media experience platforms, expecting new classes of cloud-enabled mobile media applications. These growing demands in turn require new and more poIrful cloud computing platform and infrastructure capabilities to support. Finally, the cloud mobile media paradigm will also benefit from other emerging trends in ICT

5. FUTURE WORK

Examples of related emerging technologies in ICT include, but are not limited to, software-defined networking (SDN), named-data networking (NDN), and big data analytics. For example, with the adoption of SDN, configuration and management of CDN services will become extremely convenient, further improving QoS and reducing cost; and cloud mobile media can benefit from processing the ever-growing metadata and transaction logs to provide operational guidelines.

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